Heat-insulating Dry Construction Mortars Based on Production Waste

Smbat Mazmanyan[1,a], Armine Baghdagyulyan[2,b], Tamara Sargsyan[2,c]
Hayk Sargsyan[2,d], Gayane Papyan[1,e]

[1] ''Hrazdan Cement Corporation'' LLC, Gortsaranayin Street 1, Hrazdan, RA;

[2] National University of Architecture and Construction of Armenia, Teryan Street 105, Yerevan, RA.

[a] smbat.chemistry@mail.ru, [b] a.baghdagyulyan@mail.ru, [c] tomasarkisyan80@mail.ru,

[d] nuaca@inbox.ru, [e] smbat.chemistry@mail.ru

Abstract. Compositions of new heat-insulating dry construction mortars were developed in the work, using diatomite available in the territory of RA: CEM I 52,5N class cement, the waste of Alaverdi copper-molybdenum plant. The application purposes of the above mentioned components are shown. The parameters of the compositions were compared to those of the dry heat-insulating construction mortar «PENOSTEK TM-30» highly demanded in RF market. The obtained results allow to conclude that the waste of Alaverdi copper-molybdenum plant can serve as filler that ensures the plasticity of the mentioned mortar, Sisiyan deposite diatomite can be used as heat-insulating fillers in dry construction mortars (DCM), CEM I 52,5N class cement can serve as binder in production of DCMs.

Keywords: dry construction mortars, diatomite, waste, heat-insulating mortars.

1. Introduction

Steadily increasing prices of energy carriers, as well as large quantities of man-made waste make the heat insulation of buildings and structures and the processes of obtaining new compositional building materials based on man-made waste vital.

The process of energy efficiency technologies is in the embryonic stage in the territory of RA. Thus, in the Federal Republic of Germany the heat of 250kW/m2 per year on average is consumed for heating of a private house, and in Sweden - 135 kW/m2 per year. In the territory of RA the heat of 700-900 kW/m2 per year on average is needed for heating of a similar private house.

Apart from the above mentioned circumstances decontamination issue of man-made waste is also of current interest.

2. Reserch Results

The experiment was carried out to obtain heat-insulating dry construction mortars (DCM) using the waste of Alaverdi copper-molybdenum plant.

The components of heat-insulating DCM include Portland cement, hydrated limes, fillers of different kinds and properties, porous fillers, air-absorbing additives, conjugation accelerator, hydrophobizers [1].

Each of these components has its own role in DCMs:

- 400, 500 and 600 brands of cement are used in DCMs, there are composition where CEM I 52,5N or R brands of Portland cement are also used.
- Hydrated lime is used in DCMs as it prevents formation of cracks, assures the mortar plasticity.
- The so called limestone dust the size of particles of which is <0,1mm are widely used as fillers. There are compositions of DCMs where the limestone dust is considered the only filler.
- Perlite, diatomite, vermiculite, claydite, polystyrene are used as heat-insulating fillers. The quantities of these fillers in DCMs range from 5-15% that is directly connected to the thermal conductivity coefficient and density of the obtained DCMs.

- The role of the air-absorbing additive is that it provides an opportunity to evenly distribute the pores throughout the entire volume and ensure the breathability of DCMs.

The properties of heat-insulating DCMs change depending on filler kind and its quantity.

"POBEDIT PERLITE TMD30" DCM has also been tested for comparison purposes.

The chemical analysis data of the material used in DCMs are summarized in Table 1.

Table 1. Chemical Analysis Data of the Material Used in DCMs

Material Name	SiO_2	Al_2O_3	Fe_2O_3	CaO	MgO	Loss of Incandescence
Diatomite	80,8	3,84	2,0	6,59	0,002	3,14
Waste of Alaverdi copper-molybdenum plant	62,85	10,49	9,66	6,87	0,1	7,4
CEM I 52,5N	22,87	5,38	5,01	60,87	1,05	2,63

The following parameters were defined for heat-insulating DCMs:

- filling weight,
- humidity,
- remnants on sieves,
- water quantity needed for mortar preparation,
- hydrophobic property,
- water absorption,
- air intake,
- cold resistance,
- adhesion,
- ultimate compression strength.

The test results of the obtained DCMs are given in Table 2.

Parameters of heat-insulating DCMs developed by us are analyzed and compared to those produced in RF which are summarized in Tables 2 and 3 accordingly. It can be seen that DCMs developed by us is superior by several quality parameters to "PENOSTEK TM-30" which is in great demand in RF market. These parameters are:

- water quantity needed,
- DCM expense in case of 1 cm thickness layer,
- water absorption limit within 24 hours,
- vapor permeability,
- ultimate compression strength,
- bonding strength limit with concrete.

Table 2. Test Results of DCMs

Index Name	Index
External appearance	Grey
Mortar density in dry state	320kg/m3
Ultimate compression strength	0,65MPa
Bonding strength limit with concrete	0,59MPa
Soundproofing in case of 2 cm thickness	43dB
Thermal conductivity coefficient: after 28 days after 120 days	 0,065W/(m-K) 0,050 W/(m-K)
Cold resistance	Not less than 35 cycles
Water conservation in mortar	95%
Fire safety	It doesn't burn
Vapor permeability	0,7mg/(m.h.Pa)
Water absorption limit within 24 hours	0,06kg/m2

DCM expense in case of 1 cm thickness layer	3,67kg/m2
Water quantity needed	0,47l/kg
Application time after mortar preparation	Not less than 2 hours

"PENOSTEK TM-30" DCM analysis results are given in Table 3.

Table 3. Test Results of "PENOSTEK TM-30"

Index Name	Index
External appearance	White
Mortar density in dry state	320kg/m3
Ultimate compression strength	0,63MPa
Bonding strength limit with concrete	0,59MPa
Soundproofing in case of 2 cm thickness	43dB
Thermal conductivity coefficient: after 28 days after 120 days	 0,067W/(m-K) 0,052 W/(m-K)
Cold resistance	Not less than 35 cycles
Water conservation in mortar	95%
Fire safety	It doesn't burn
Vapor permeability	0,72 mg/(m.h.Pa)
Water absorption limit within 24 hours	0,062kg/m2
DCM expense in case of 1 cm thickness layer	3,73kg/m2
Water quantity needed	0,49l/kg
Application time after mortar preparation	Not less than 2 hours

3. Summary

The results allow the following conclusions to be drawn:

- The waste of Alaverdi copper-molybdenum plant can serve as filler that ensures the plasticity of the latter.
- Sisiyan deposite diatomite can be used as heat-insulating fillers in DCMs.
- CEM I 52,5N class cement can serve as binder in production of DCMs.
- Technical and economic indices of the mentioned mortar will be studied later, as well as the application time after mortar preparation will be clarified that is of great importance in construction.

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